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A Wrong Course.

For many years we have thought a weekly journal which appealed to all owners of horses would have a successful career.

The first number of *The Stable* has appeared, and the editorial column tells its readers the line it proposes to follow. One paragraph is as follows :—

> "Knowing the difficulty that is often experienced in getting a trustworthy opinion as to the soundness of a horse offered for sale, we are making arrangements throughout the United Kingdom by which we hope in a short time to be able to recommend a veterinary surgeon in any locality where the special services of one may be urgently required. We shall be grateful for any assistance that may be rendered us in the compilation of such a register. The recommendations of Masters of Hounds will be especially esteemed."

Whilst we wish every success to the new paper we must make a strong protest against this curious departure. The invidiousness and unfairness of the proposal should really be evident to anyone. The three or four thousand veterinary practitioners in the kingdom may be of some value as readers of a paper devoted to horses and stables, but the absolute impertinence of this suggestion will only raise the strongest feelings of antagonism. Just imagine what doctors or lawyers would think of an editor who offered his innocent readers a register of selected professional men!

We feel certain our contemporary will drop this unwise proposal as soon as he convinces himself of the views of veterinary surgeons. Surely the diploma granting body, chartered by law, is better able to say who is fit to practise than even the most able editor.

With the coming of the New Year, Editor and Publishers alike have again to thank many correspondents for kindly words of appreciation—always received with pleasure, and for seasonable wishes, which they heartily reciprocate. To the readers the weekly number comes with, perhaps, a little pleasing expectation of something fresh, and we have evidence that to many of our foreign and country subscribers it is very welcome. To the makers the pleasure is more alloyed. The work, if not very heavy, is almost continuous, and, as all such work, is inevitably sometimes wearisome. We should like to please *all* our readers, but from the first have had to recognise the impossibility of doing so. Next to that we are glad to find that we succeed in pleasing many of them, and correspondingly gratified when they tell us so.

THE UNION OF WOUNDS.

By Thomas Pickering Pick, F.R.C.S.

(Abstract of the "Bradshaw" Lecture delivered before the Royal College of Surgeons in December last.)

Many surgeons and pathologists, and amongst them some of the most eminent in this country and on the Continent, believe that the union of wounds takes place without inflammation, and indeed assert that "repair in all its forms is effected without inflammation." These pathologists teach that "repair and inflammation are not only not identical, but that they are incompatible. That repair is a constructive physiological process and resembles closely that of development and growth; but that inflammation is a destructive pathological process, brought about entirely by micro-organisms introduced from without, and that when it attacks a wound in the process of repair, it at first checks repair, and later on brings about disorganising changes, and when a part repairs after it has been the seat of inflammation, it does so only when the inflammatory process has been arrested."

Other pathologists, again, hold the opinion that all wounds unite by a process which they regard as inflammation. And while admitting that inflammation is a destructive pathological process, they believe, nevertheless, that the union of wounds takes place by it, and that there is a decrease in the vital activity of the affected tissues, and, as a result, a lower vitality in the product of this inflammatory process; I mean in the scar or connecting medium, which binds the severed parts together.

I do not propose to weary you with the opinion of the older pathologists. I prefer rather to limit myself to a consideration of the question, as it exists at the present time, as to whether wounds heal without inflammation; and I take as my text on which to base our discussion the words of Karl Roser, of Marburg, a German pathologist of great repute. He says: "The clean, non-infected wound heals without inflammation by first intention; the infected wound, on the contrary, heals by second intention with the appearances of inflammation. In the first case healing follows immediately after the injury. In the other case inflammation intervenes between injury and healing as a disturbing complication."

What is Inflammation?

Clearly the first point in considering this question is to have a clear and definite understanding of what inflammation is. As you are all aware, Burdon Sanderson has defined inflammation as the "succession of changes which occurs in a living tissue when it is injured, provided that the injury is not of such a degree as at once to destroy its structure and vitality." Or, more briefly and succinctly, that inflammation is the "response of living tissues to injury." Now, if we accept this definition, the whole question falls to the ground at once. Clearly, if this is true, no wound can unite without inflammation; a wound is an injury; therefore a response must take place, a succession of changes must occur which constitutes inflammation. Those, however,

who believe that wounds heal by a strictly physiological and constructive process clearly do not accept this definition of the word, and regard inflammation as something else.

The older definition of inflammation was that it was that condition which was attended by certain, so-called, cardinal signs—pain, heat, redness, and swelling, and that we must regard these signs, again to quote the words of Dr. Burdon Sanderson, "as the characteristics of the thing of which the word 'inflammation' is the name." There is no question that these signs do attend or follow a wound, and so again, we must admit that if the aggregate of these signs constitutes inflammation, then that there is inflammation during the process of healing of a wound.

The opponents of the doctrine of the healing of wounds by inflammation do not, therefore, hold that the presence of these four signs necessarily constitute inflammation; and no doubt this, in fact, is quite true. They are present in that condition which indeed is the first stage of the inflammatory state, but which may also occur quite independently of it; a condition to which we apply the term "determination," and which is undoubtedly a physiological process, and is an element in thousands of actions of daily life, and occurs in those conditions where a sudden increase of blood is required for some physiological purpose. Thus, a morsel of food is introduced into the mouth, requiring an increased quantity of saliva for its salivation; immediately a determination of blood to the salivary glands takes place, causing a more active secretion and an increased flow of saliva.

This determination, which we admit is a physiological process, is attended with a sudden afflux of blood to a part, and is characterised in consequence by certainly, at least, three of the four cardinal signs of inflammation: heat, redness, and swelling; and, possibly, also, in many cases, by the fourth also; for, at all events, if there is not actual pain, there is an uneasy or abnormal sensation, such as a sensation of fulness about the part. It is evident. therefore, that we are not in a position to say that a part is inflamed because of the presence of these four symptoms.

I have alluded somewhat at length to this question of determination, because I think it is important, with a view to accuracy of statement, that the employment of the word "determination" should be strictly limited, when used in connection with the inflammatory process, to the primary acceleration of the blood stream in and about an injured part, and should not be so extended as to comprise the subsequent stages of retardation resulting in stasis and exudation.

We have not yet arrived at our definition of inflammation; and, indeed, the difficulty is great in giving a clear and logical definition to this form of disease, although we easily recognise the condition, and understand the combination of processes which are taking place in the tissues.

I should regard inflammation as a modification of the normal physiological processes in the various tissues of the body, resulting from the application of some irritant to the part. This process being attended or followed in most cases by the formation of a new material of a less highly organised nature than the original tissue in which the inflammation has taken place.

And here I would draw your attention to a very important point, and one which it is very desirable that we should keep strictly in our minds, and that is, that these cases of what we may call "traumatic inflammation"—that is to say, inflammation produced by a wound in which no foreign body is allowed to remain—and which inflammation is, as I hold, necessary for the healing of the wound, are very different from those inflammatory processes which are due to the admission of septic organisms. And they differ especially in this marked peculiarity—that the irritation in the tissue does not extend beyond the immediate neighbourhood of the injury. The irritant which has produced the inflammation has been momentarily applied, and therefore the inflammation which results has a tendency speedily to resolve itself as soon as it has brought about those changes which are necessary for repair. This is very different from those cases where a prolonged irritant is applied to a part; then the process of inflammation is also prolonged, and when this irritant is some septic organism which has the power of multiplying in the tissues and of producing ptomaines which poison the tissues, the inflammation is not only prolonged but has a tendency to spread and diffuse itself rapidly by continuity of tissue.

It must be admitted on all hands, I think, that in the process of union of wounds there is the formation of a new tissue which forms the bond of union, and the point which we have to discuss is whether this new tissue is the result of inflammation or whether it is merely a physiological process, a condition of ordinary development or growth which is constantly taking place in the body. If we regard the subject from a clinical aspect, I admit that there is considerable difficulty in making any distinction between these two conditions. For, as I have endeavoured to show, we may have all, or almost all, the signs of inflammation as the direct outcome of a physiological process, and, on the other hand, we often meet with cases of wounds which heal without any of the four cardinal signs being present in any marked degree at the margins of the wound, though I believe they are always present to a certain extent, though it may be this extent is not appreciable to the ordinary observation. And it must be borne in mind that the difference between slight redness, swelling, and heat of the edges of a wound and the most intense form of these conditions is only one of degree, the latter being patent at the merest glance to the most superficial observer, whilst the former is so slight as to be scarcely distinguishable to the most careful investigator. When, however, we come to consider the question from an histological standpoint, it seems to me that we cannot separate it from an inflammatory process, however slight its extent and intensity may occasionally be.

What Happens in a Wounded Part.

Suppose we make an incision through the skin into the subcutaneous tissue beneath. What happens? First it bleeds; then the bleeding ceases, and finally union takes place. The wound first bleeds because the capillaries contained in the tissue are divided; the bleeding stops because the blood coagulates in the capillaries so far as the nearest anastomosis, that is to say, to the next point of intersection of the capillary network. So that the first change is that all the cut vessels become filled with clots up to their first collateral branch, and this is undoubtedly simply a physiological process; the clotting being the result of the physiological conditions which brings about the formation of fibrin.

Secondly, the capillary vessels in the neighbourhood, that is to say, beyond the point of clotting, will be noticed to be dilated. By some this would also be regarded as a physiological process, and to arise merely from mechanical causes, from the increase of pressure to which the capillaries have been subjected in consequence of the coagulation which has taken place in their several extremities. About this I shall have to say a word or two in a moment, but let me first glance at the other changes which are to be observed in a wound before the process of union is effected.

The third change to be noted is in the connective tissue in which the vessels ramify. This becomes infiltrated with cells, and these cells multiply, so that we have the tissues at the edges of the wound infiltrated with a vast accumulation of cells, which are for the most part simple, nucleated cells, re-

sembling leucocytes. After a time other larger cells appear, and some of these find their way to the surface of the wound, and are to be seen covering it.

Fourthly, the cells which cover the surface of the wound undergo a developmental process, and first become spindle-shaped and then fibre cells, are eventually converted into fibrous or scar tissue, which forms the cicatrix or bond of union.

Finally, and lastly, the capillary network at the margins of the wound prolongs itself in the form of loops into this new tissue, and becomes continuous with similar loops on the opposite side, and thus the new tissue becomes an organised structure, and unites the edges of the wound together.

These, very briefly, are the changes which can be observed with the microscope as taking place in the edges of a wound, whereby union is effected; and the question we have to consider is whether these changes are strictly physiological and akin to those of development or growth, or whether they are the result of that pathological process which we know as inflammation. Whether, in fact, these cells which are the essential elements in the process of union find their way between the edges of the wound in conformity with known physiological laws, and, having found their way there, undergo changes similar to those which are witnessed in the embryo, when the blastodermic cells of the ovum grow, develop, and differentiate into the various structures of the human being, or whether these changes take place as the result of a pathological process, altogether different and distinguishable from normal physiological action.

In discussing this point, we shall have to consider four questions: (1) Is the dilatation of the blood vessels, which we described as the second change in our process of union, simply a mechanical one, and due to the increased pressure exerted on the capillaries of the part? (2) Is the vast accumulation of cells in and around the wound the simple outcome of a physiological process? (3) Are the changes which take place in the cells exactly identical with the mode of growth and development in embryonic cells; (4) And, lastly, What is the nature of the newly formed tissue?

The Dilatation of the Blood Vessels.

The first point, then, which we have to consider is whether the dilatation of the blood vessels, which undoubtedly occurs, is simply due to mechanical causes. We have seen that when a wound is made the blood vessels at its margins become blocked, and it is perfectly clear that the blood will have to accommodate itself to this, and find another channel by the existing and patent by-paths around the blocked vessels. The result of this is increased pressure in these parts, and, as a consequence, distension and dilatation of the vessels. So there can be no question that in this simple mechanical explanation there is a way in which we may account for the dilatation of blood vessels, but unfortunately this mechanical explanation does not fully account for the subsequent changes which take place. It fully explains the first step in the process—the determination with increased motion—but it does not explain the determination with diminished motion, in which the circulation becomes slower and slower until the retardation results in stasis, with consequent diapedesis. For this we must look to some other cause than a mechanical one, and hence, as it is certain that this slowing of the blood current does take place, we cannot accept the theory that the dilatation of the blood vessels in inflammation is entirely due to a simple mechanical cause. To what, then, must we attribute this dilatation and this increased flow of blood? Numerous hypotheses have been advanced at different times as to the cause, and it cannot be said that even at the present time any one of these hypotheses gives a really complete and absolute explanation of the phenomenon. In considering the question I would strongly emphasise and ask you to bear in mind the words of Sir John Simon, who says that "part does not inflame because it receives more blood; it receives more blood because it is inflamed." For if we do not admit this, the whole argument falls to the ground.

It is self-evident that the proximate cause of the dilatation must be change in the tonicity of the muscular coat of the vessels, and the question we have to determine is how this change of tonicity is brought about. It at once suggests itself that this may be due to some irritation which disturbs the function of the nerves of the vessels. And this may to a certain extent be so, especially as it has been proved by direct experiment that irritation of a sensory nerve causes dilatation of the arteries in the whole area to which the nerve is distributed. Why this irritation of a nerve should produce this active, directly paralysing effect is not quite so clear, though I think it may be very fairly explained in the following way. We know that the vagus nerve possesses an inhibitory action upon the heart, and that irritation of this nerve produces a diminution or obstruction in the action of this organ. We therefore assume that there is an inhibitory nervous system which arrests the contraction of muscles. And if this is true of the heart, why should it not also be true of the blood vessels; and why should we not assume that the muscular elements of the blood vessels, like the heart, are under the control of both the sympathetic and the cerebro-spinal system; the former of which causes the rhythmical contraction of the vessels, and the latter regulates and obstructs their contraction?

If this is so, it would explain the reason why irritation of the cerebro-spinal nerves would exert an inhibitory effect upon the muscular coat of the vessel, and a consequence vascular dilatation. But it is quite clear that this explanation of the cause of the dilatation of the blood vessel is not sufficient to explain the phenomenon. It is true that part of the dilatation may be due to this cause, but I am inclined to think it is only a very small part; for it is clear that if this was the cause, and the sole cause, the dilatation would not be confined to the injured area, but would embrace all those parts supplied by the nerve irritated. Moreover, experiment and clinical experience negative this view. The experiments are those of Cohnheim, who has shown that in the tongue of a frog, after its nerves have been severed, the process of inflammation can be excited by almost any irritant, and, indeed, that where the tongue has been severed from all its connections, so long as the arteries and veins are allowed to remain intact an inflammation can be excited by similar causes. It is certain here that the dilatation is not dependent on any influence conveyed to the blood vessels from the cerebro-spinal centre.

Clinical experience also points in the same direction. I need only allude, in illustration, to the fact that it is a matter of every-day experience to see inflammation set up in paralysed parts, where the nerves clearly can have nothing to do with the primary condition of dilatation. We must look, therefore, to another cause to explain the dilatation which takes place in the inflamed area. I think it may be briefly stated to be due to the direct effect produced upon the vessels of the part by the injury that has caused the disturbance, or, in other words, that the irritation disturbs directly the function of the muscular coat of the arteries and veins and the living cell substance of the capillary walls. This is in strict accord with Cohnheim's so-called "alteration" theory of inflammation, namely, that the "alteration of the physiological condition of the walls of the vessels is the cause of those phenomena and processes the sum of which is designated by the term inflammation."

The grounds on which Cohnheim based this proposition was by cutting off the circulation from a part for a

certain length of time, say twenty-four hours, by encircling it with a ligitature, and then at the expiration of this time loosening the ligature and restoring the circulation. By this means he produces as typical and intense an inflammation as by subjecting the part to the direct action of an irritant. If, then, this undoubted alteration in the walls of the blood vessels—the part with which the blood first comes into contact in these experiments—causes them to act as if they were inflamed, may we not assume that a similar change takes place in the vessels when inflammation is set up by other causes, and induces a similar result?

If we accept this as true we have a strong argument in support of the view that inflammation is necessary for the repair of tissue, and therefore for the union of wounds. For we have here in the vessels a deterioration of tissue, a retrograde metamorphosis, which certainly cannot be regarded as a healthy physiological action; a something which is quite different from the *affluxus sanguinis*, the active congestion or determination of blood which is due entirely to nerve influence.

The Accumulation of Cells.

We pass on now to consider the second question which I set myself—namely, is the vast accumulation of cells in and around a wound during the process of healing the simple outcome of a physiological process? In order to answer this question, we have to ask ourselves another: Whence do they come? I suppose there is no one here present who would hesitate in answering that, at all events to a very considerable extent, they are emigrated leucocytes. And this is undoubtedly one source from which they are derived, though I think there is very little doubt that they are also in part derived from a second source. Into this point, however, it is foreign to my purpose at present to enter; and it is sufficient that we believe that the myriads of round cells which we see in and around a wound during the early stage of the healing process were originally derived in part from the leucocytes which have passed out of the circulation through the walls of the capillaries. We then ask ourselves another question, Why has this emigration taken place? It is a condition very different from what we observe in health. For though it cannot be denied that exudation of the plasma of the blood takes place as a physiological process, and emigration of the leucocytes very probably does so, still it is a very different condition to what we see in a wounded part, and we never find in healthy tissues the whole of the structure infiltrated with leucocytes to such an extent as almost, if not quite, to obscure the natural structure of the part. There is no doubt that the answer to this second question is that the emigration is due to stasis, or that condition of arrested circulation which we know speedily follows the dilatation of the blood vessels in an inflamed part. What is the cause of this stasis.

Many theories have at different times been put forward to explain this phenomenon. It has been attributed to the dilatation of the blood vessels, to changes in the corpuscles, and to changes in the tissues, especially the lining membrane of the walls of the vessels. It cannot be due to the dilatation of the walls of the vessels, because we do not find a similar phenomenon attending the dilatation of vessels from other causes. Divison of the sympathetic in the neck of an animal causes dilatation of all the vessels of the head and face, from paralysis of the muscular coat of the blood vessels, but there is no tendency to stasis or arrest of the circulation. Then, again, it cannot be due to changes in the corpuscles; for if we examine under the microscope the mesentery of a frog in which inflammation is slowly set up from exposure to air, we may watch a leucocyte showing a tendency to stick to the wall of the vessel so long as it is contained in the inflamed area; it partly adheres, oscillates to and fro, but gradually makes progress onwards till it reaches the extreme limit of the inflamed area, when it at once loses this tendency to adhere, and flows on rapidly in the normal course of the circulation.

Another reason why it cannot be due to changes in the corpuscles is because if it were we must assume that not only the corpuscles in the inflamed area are changed, but all the corpuscles throughout the body, and therefore this same adhesiveness must be observable in every vessel in the body, for only one small portion of the blood was acted upon by the irritant which set up the inflammation, and the blood in the area of stasis cannot be that which was thus acted upon.

Stasis must therefore be due to changes in the walls of the vessels, or the tissue with which the blood comes in contact, so that the corpuscles when they pass into the injured area acquire a tendency to adhere. The lining membrane of healthy vessels differs from every other solid in the fact that the corpuscles have no tendency to adhere to them, and therefore no coagulation of the blood takes place; but when the corpuscles, and especially the leucocytes, come in contact with any foreign body, that is to say, anything else except the healthy wall of the vessel, they show an immediate tendency to adhere to to it, disintegrate and set free their fibrin ferment, and coagulation is the natural result. The same thing holds good if the lining membrane becomes altered in structure or diseased. It no longer possesses the power of repelling the corpuscles, but, on the other hand, attracts them and causes them to adhere. It acts as a foreign body. Look, for example, at many cases of thrombosis, where the coagulation is due to an altered state of the vessel wall, which causes the leucocytes to adhere to it, and as a consequence the vessel becomes occluded with clot.

In the fact, then, that in the union of wounds we have the tissues in and around the wound infiltrated with cells, we have another strong argument in favour of the theory that the union of wounds is an inflammatory process. This infiltration with cells is the direct outcome of stasis in the vessels, and this stasis is a necessary result of their deterioration or retrograde metamorphosis which can scarcely be regarded as a physiological process.

The Changes in the Cells.

In connection with the third question which we set ourselves to consider, whether the changes which take place in the cells, which are now believed to be in a great measure large mobile cells formed by proliferation of the original cells of the part, which have replaced the emigrated leucocytes, are exactly identical in their mode of growth and development with embryonic cells, I am bound to say that I know no difference. It seems to me that we must acknowledge that these cells of granulation tissues are exactly identical with embryonic cells, and behave in the same manner, undergoing the same form of development into higher tissues. It would appear that the recognition of this fact has caused objections to be raised against designating as inflammatory the purely regenerative processes which take place in the healing of a wound. But I would contend that it in no wise invalidates my argument that the new formation of tissue which leads to the adhesion of wounds is inflammatory. My contention is that this newly-formed tissues, which is by a process of development eventually to form scar tissue, or the bond of union between the severed tissues, is the result of an inflammatory process, though the subsequent steps by which it undergoes development into scar tissue may be distinctly physiological, or at all events identical with processes which take place in the blastodermic membrane of the embryo, where the primary nucleated masses of protoplasm of which it is composed undergo changes of growth, multiplication, and differentiation until they become converted into complete animal cells of many different types. It is

the mode of origin of the cells, and not their subsequent changes which marks off the process of union of wounds as an inflammatory one.

The Nature of the Uniting Tissue.

Leaving this point we pass on to consider the fourth and last question which I stated it was my intention to bring under your notice in elucidating the point which we have under consideration. The question is as follows: What is the nature of the newly-formed tissue which acts as a bond of union, and joins the two severed surfaces together? And in the answer to this question I think we shall find one of the strongest arguments in favour of the view for which I am contending—namely, that wounds always unite by a pathological process which we term inflammation.

The elucidation of this point will require a little careful consideration. So long as tissue elements retain their vitality they possess the power of undergoing nutritive and formative changes on the application of a physical or chemical stimulus. Up to comparatively recent times the knowledge of this fact caused pathologists to regard inflammation as a condition of increased, though perhaps perverted, activity of the process of nutrition. The converse of this is, however, the fact. Lord Lister was the first to initiate the doctrine that "inflammation consists not in increased, but in diminished vitality of the tissues affected." The process of inflammation, whether showing itself by enlargement, multiplication, or formation of cells is always a sign of lower vitality, and results, as Dr. Burdon Sanderson expresses it, in "tissue spoiling and not in tissue stimulation." And the more rapid the rate of reproduction, the less is the stability of the newly-formed tissue, and those tissues which are the result of the inflammatory process are always more lowly organised and of a lower vitality than the original tissue of the part before the process of inflammation took place. Inflammation must therefore be regarded as a destructive process. If we admit this—and who will gainsay it?—we have an extremely strong and potent argument in favour of the fact that the scar tissue or bond of union in a wound is a product of inflammation, and not a new formation the result of a physiological process.

Let us briefly consider what scar tissue is. It is composed of dense white fibrous tissue, which differs from the normal tissue, which it has replaced, in many important particulars. And, as Rindfleisch says. "Cicatricial tissue is far from being a connective tissue of ideally high quality." It is more dense than ordinary areolar tissue, and contains no yellow elastic fibres. It is smooth on the surface, and presents no papillæ. It is devoid of sweat glands, sebaceous glands, or hair follicles. It contains no lymph spaces or lymphatics, and nerve fibres are very few in number or altogether wanting. When first formed it is vascular, but its vessels soon disappear, and it becomes dry, hard, and white, and of lower organisation than the natural parts. Moreover, scar tissue is exceedingly prone to diseases of degeneration.

If, then, this is the character of scar tissue, it can scarcely be regarded as the product of a healthy physiological process, and it becomes a powerful argument of the view that union of wounds is an inflammatory, and therefore a pathological process, and not a physiological one.

The Different "Methods of Union."

In our textbooks on surgery it is customary to describe five classical ways in which wounds unite: (1) by immediate union, primary adhesion, or direct growing together of the severed surfaces; (2) by first intention; (3) by scabbing; (4) by second intention; and (5) by secondary adhesion or growing of two granulating surfaces together. To these I think we ought to add another—namely, healing by blood clot. It will be my endeavour to show that there are only two ways in which union of wounds takes place—namely, without suppuration and with suppuration; and, moreover, that the difference between these two conditions is very slight, being one more of degree than of kind, and that they are both the result of the same morbid process going on in the part—that is, inflammation.

By Primary Adhesion.

Let us consider these different modes of union a little more in detail. It is the first of these that I most desire to consider, because it is a mode of union in which the essential principal was laid down by Macartney, of Dublin, who first described it, that there was no inflammation. He says: "Union takes place without any intervening substance, such as blood or lymph."

It seems to me that we must acknowledge the presence of some connecting material which shall first cause the cut surfaces to stick together, and through which they shall become continuous, just as much as in the case of two pieces of wood, which we cannot make stick together without the intervention of some adhesive material.

I, for one, therefore, must discard the doctrine of the first mode of union of wounds as untenable. I explain those cases in which it is said to occur, and I must confess that I have never been so fortunate as to observe the process in my own experience, as cases where the inflammatory process is reduced to a minimum, and where therefore the adhesive material is correspondingly small.

Direct experiment negatives the proposition. If a wound, however small and however carefully adapted immediately after its infliction, be made, it will be found upon killing the animal and making sections of the injured part that there is a greater or less amount of connecting substance between the edges of the wound. Even if a very small incision be made through the cornea of a rabbit with the sharpest knife, and be prevented from gaping by at once closing the eye, the resulting cicatrix will be invisible to the naked eye, but nevertheless the intermediary substance may be demonstrated on microscopic examination. It seems clear to me therefore that we must exclude this fancied method from our category of modes of union of wounds, and arrive at the conclusion that, when union takes place very rapidly and without the ordinary signs of inflammation being appreciable to the senses, the difference is merely due to degree, and that the same changes take place here as in the so-called union by the first intention, though to a less extent. For who shall say how much hyperæmia, how much exudation, what amount of new formation of tissue is necessary to agglutinate and unite the edges of a wound together.

By First Intention.

We proceed, secondly, to allude to the second mode of union of wounds, viz., union by first intention or by, as I believe, adhesive inflammation. I shall not say more about this mode of union than to mention that this would correspond to my suggested first division, that is to say union without suppuration. I have already discussed this process very fully and the changes which take place in the part up to the conditions of complete union, and which changes are admitted by all whether they are believed to be due to an inflammatory process or not. We pass on therefore to union by scabbing. This I believe to be merely a modication of the process of union by first intention, and not to be worthy of being placed in a distinct class by itself. When a wound heals by scabbing the separative material which is poured out undergoes similar changes to those which take place in the same material when the wound heals by first intention, the scab merely forming a protective film over

the wound and preventing decomposition or putrefaction. Union by blood clot is another mode of union which can only occur in an aseptic wound and has only recently been described. It is merely another modification of union by first intention or by adhesive inflammation when the edges of the wound are not in contact, but are separated by blood clot, which acts as a mould or framework into which the leucocytes and the plasma cells, the result of the inflammatory process, penetrate, and where identically the same changes go on as in those cases where the edges of the wound are in close contact and where there is nothing between them but inflammatory exudation.

It is obvious that all these modes of union are merely modifications of one process and are identical as far as regard the changes which take place. They may therefore, I think, with propriety be classed together as modes of union of wounds without suppuration.

By Second Intention and by Granulation.

It remains for us now finally to consider the two other processes or modes of union of wounds, namely, union by second intention and union by secondary adhesion, or as it is sometimes called "third intention"—two modes of union which I would venture to class together in one group as cases of union with suppuration.

With regard to this mode of union it will be seen, I think that it is merely a modification of the mode of union we have already described; that in both the essential features are identical, and that the difference in the two is one rather of degree than of kind. The difference is the two would appear to be due to some circumstance which produces a prolonged irritation, and therefore the resulting inflammation is prolonged, and the amount of inflammatory exudation is increased. If we examine the changes which take place in this mode of union, we find that we have the same initial changes; the same blocking of the severed vessels; the same hyperæmia around, and the subsequent stasis, and the same exudation of what Hunter termed "plastic lymph." But instead of this exudation being slight in amount, and speedily ceasing, it goes on and on until the surface of the wound becomes covered with a considerable layer, too thick to be nourished by the vessels in the underlying tissues. From malnutrition, therefore, the cells in the superficial layers undergo degeneration, and are converted into pus cells, and thus suppuration takes place. At the same time the deeper layers become vascular and converted into granulations, which undergo cicatrisation, and so the wound is healed. There can be no question, I think, that the cause of the prolonged irritation is the presence of septic micro-organisms in the wound.

Time will not permit me to describe the process in detail, but sufficient has been said for my purpose, which is to point out the close analogy between the process of union by first intention, and union by second intention. In both there is inflammation; in both this is attended with exudation, though varying in amount; and in both this exuded material forms the bond of union.

In union by secondary adhesion or "third" intention we have the same exudation of inflammatory material acting as the bond of union. We have inflammation, exudation, and the conversion of the exudation into granulations. If these granulations are now brought in contact they coalesce together, just in the same way as the exudation does in union by first intention. The vessels grow through this coalesced material from side to side of the wound, the cells of which it is composed undergo developmental processes, and are converted into scar tissue and the union is complete.

Such, then, Mr. President and Gentlemen, are briefly my views with regard to this important question of inflammation in connection with the union of wounds. The whole subject hinges on the one point of what we mean by inflammation. If we agree with Hueter and Kocher that no injury alone is competent to produce inflammation without the intervention of micro-organisms, then my whole argument falls to the ground. But if we believe, as I do believe, that inflammation may be adduced without the concurrence of organisms—an inflammation, I admit, different from that excited by these bodies, for it neither tends to spread to contiguous parts beyond the area of injury, nor to infect distant parts through the blood stream or otherwise—then I say I have brought forward conclusive evidence to prove that the union of wounds is an inflammatory process. At least, if it is not, I know not what it is.—*The British Medical Journal.*

ARROW POISONS: THEIR HISTORY, SOURCES, AND CONSTITUENTS.

By Ralph Stockman, M.D., Professor of Materia Medica in the University of Glasgow.

At the present time, except in the darkest places of the earth, the gun has completely ousted the bow as an instrument of warfare and of the chase. Even in those places which, by comparison with the darkest, we may call dark and darker, the enterprise of traders has introduced guns and gunpowder, and as soon as this happens it becomes the ambition of every savage to be the proud possessor of a weapon which at once gives him a superiority over his neighbour as a fighter and hunter. As with ourselves, superiority, or at least equality, of armament is a necessity for self-preservation and national existence, a state of matters which the savage is as quick to appreciate as his most civilised brother can possibly be. As a result, we are within measureable distance of a time when the bow and arrow will have disappeared as a serious weapon of offence and defence except in the most inaccessible parts of the world. This has already happened in many countries, and in some parts of Africa within living memory, while in others we can observe the process going on. Already in certain nations and tribes skill with the bow is a thing of the past, the making of bows and arrows is a neglected art, the preparation of poisons to render them more deadly is no longer practised, and in many cases will have been forgotten before we have become accurately acquainted with their ingredients. Nevertheless, the bow and arrow have had a long and fateful career, and their history is intimately bound up with the fortunes of great nations.

The battles of Hastings, Cressy, and Poictiers, not to mention others nearer home, were decided by superior archery, while English and Scottish kings and parliaments have in the past frequently taken measures, and enacted stringent laws with the view of developing and improving the national skill, and of ensuring throughout their realms a sufficient supply of well-made bows and arrows.

The arrow is a weapon of the greatest antiquity, as cave remains, the oldest sculptures, and its use at the present day by the most primitive tribes all go to show. Nor was it a weapon to be despised. The range of the English Archer was from 120 to 360 yards, his accuracy was deadly, and the force such that the arrow easily penetrated an inch thick plank. Stanley, after an encounter with the Avisibbas, in which he lost several men, found that with one of their bows he could easily drive an arrow through both sides of a large biscuit box, and that he was able to shoot another over a high tree 200 yards distant. He adds that at short range such an arrow will go completely through a man, and it is said that in his palmy days the North American Indian occasionally drove one through a buffalo. Few of the

tribes with which we are acquainted are capable of using them with deadly effect at longer ranges than from 50 to 100 yards, but their penetrating power is very great, especially if they have a heavy shaft, and they make a dangerous punctured and incised wound. The English archer drew the shaft to his ear and took deliberate aim, but savages, especially in the excitement of battle, hold both arms more less extended and only draw the bow-string a certain distance towards the body. A number of arrows are held in the bow hand with a reserve in the quiver, and under these conditions they are able to fire off about six per minute with good aim. If the archers are numerous, therefore, a shower of arrows is not an exaggeratted metaphor.

The typical arrow consists of three parts, the head made of iron, bone, flint, or other stones, the shaft, in the fashioning of which great skill is necessary to have it straight and true, and some sort of clamp or cord to unite these. Many, however, consist of a simple wooden shaft sharpened at one end and hardened by fire, and the small darts used for killing birds and lesser game are always of this description. The head itself is often barbed, or barbs are placed behind it or are cut in the wood, to prevent extraction, and some of these look truly murderous weapons. As nowadays with gunshot wounds, so to the ancient surgeons arrow wounds were of supreme interest, and such authors as Hippocrates, Celsus, and even Ambroise Paré devoted a large space to the consideration of their effects and proper treatment.

The practice of smearing arrow-heads with poison to enhance their deadly effects must be very ancient, although until quite recent times the accounts given of it have been very vague and meagre. Lagneau states that in cave remains of the palæolithic period in France arrow and spear heads have been found made of bone and marked with depressions for containing poison. These, he thinks, were certainly used to destroy such large animals as the bison and reindeer, and were probably also employed in warfare. To the Greeks arrow poisons were well known. Their word "toxicon"—whence we derive "toxicology"—was a poisonous substance into which the arrow—"toxon"—was dipped. Hercules is fabled to have used poisoned arrows; Homer mentions them in the 'Odyssey,' and Alexander the Great, in his conquest of Asia, met with people who employed such missiles against his troops.

Ovid, who lived on the shores of the Black Sea during his banishment from Rome, speaks of the bile and blood of vipers as being used to poison weapons, while Horace, in his ode to Aristins Fuscus, enumerates poisonous arrows among the evils which the man of upright life and free from crime need not fear. The widespread nature of the idea, however, may be better grasped from the prevalent belief that pestilence was due to arrows shot by one or other of the offended gods, while even such an impalpable feeling as love was conveyed into the heart by means of Cupid's darts. The Scythians were well known to use arrow poisons, and they and the tribes of the Caucasus were commonly supposed to use viper poison mixed with putrefied human blood serum.

As regards the use of poisoned arrows and other weapons in Europe, Aristotle and Strabo mention the practice as common among the Celts. In hunting, the Gauls are stated (Pliny) to have employed arrows dipped in hellebore juice, and before eating the animal to have cut out the part around the wound, a practice similar to that of African and Asiatic peoples at the present day.

Celsus states that the poison used by the Gauls was not deadly if swallowed, and remarks that in this respect it resembles the venom of serpents. If this be correct, it points to the use of snake poison rather than of hellebore, but both may have been employed. In ancient Germany similar customs seem to have been in vogue, for Quintilian (A.D. 388). having crossed the Rhine with his troops, was met in battle by the natives with arrows which caused mortal wounds, no matter which part of the body they struck.

Public opinion, however, in Europe early turned against the use of poisoned weapons, for in the fifth century we find the Salian Franks making it a crime to use such arrows, and in the seventh century the Bavarians passed a similar law. Up to the seventh century poisoned arrows were common among the Dacians and Dalmatians and along the shores of the Danube. As late as the thirteenth century, at least, poisoned daggers and swords were used in Europe for assassination purposes, and very much later, even to the sixteenth century, poisoned arrows and other weapons were well known in Spain. These, however, were probably prepared by experts in poisons, and their use was not common among the people.

There is also contemporary evidence that during the later middle ages poisoned arrows were occasionally employed for killing large wild animals in the remote districts of France and in Switzerland.

It is very difficult at the present time to determine exactly what poisons were employed in Europe, as the meaning of many of the names has become totally lost. The different species of poisonous hellebore—*H. niger*, *Veratrum album*, *V. viride*—were certainly used, as was also aconite, and probably belladonna, besides the venom of the viper and other snakes. But none of the other plants named by different authors can be identified, the descriptions being for the most part rather vague, and probably derived from heresay evidence only. In the sixteenth and seventeenth centuries it became widely known in Europe that the aborigines of South America and Western Africa were in the habit of employing poisoned arrows in warfare and in hunting, and now for a long time past these poisons have been objects of great interest to explorers and pharmacologists. A very large number of the different poisons used by tribes all over the world have now been more or less carefully examined physiologically, the botanical sources of many of them have been accurately determined, and the plants have even in some cases been grown in Europe, while we have also, as regards a few of them, detailed accounts by Europeans of the exact methods of preparation in use among the savages. Such information has proved very difficult to obtain, as the secret is always most jealously guarded, and in some tribes is only known to certain families or chiefs, who pass it on to their successors. Some of the poisons are still quite unknown to us and others very imperfectly so, but in their mode of preparation and in the kind of ingredients commonly used there is a certain family resemblance all over the world. Thus we find that snake poison, poisonous insects, poisonous fish, and other animals are commonly employed, while plant juices or watery decoctions inspissated to the consistence of thick tar by heat form the basis or the sole ingredient of the majority. Many of them are mixtures of different poisonous vegetable products, some again are mixtures of animal and vegetable poisons, and this complexity of composition often makes it most difficult to determine a real nature of the poison. When freshly made they have generally the consistence of thick tar, and are carefully put up in neatly constructed receptacles made usually of vegetable fibre or in small calabashes, such as I now show you. In some cases the poison is smeared over the arrow-head, in others it is laid on thickly just behind the head for a distance of two or three inches. Among all savage tribes the head is very loosely attached to the shaft, so that the poisoned portion cannot be drawn or knocked out, but remains firmly fixed in the tissues, no matter what happens to the rest of the arrow. In the case of wooden arrows the shaft is sometimes partially cut through near the poisoned end, so that attempts at extraction by man or

violent contact with bushes in the case of an animal which had been hit, snap it off short, and leave the poisoned part in the wound. I also show you some darts from Borneo, made of wood and poisoned at the point, these being shot through a blow tube. It is very noticeable that the quivers both for arrows and for darts are most carefully made with a cover for the poisoned head, so as to avoid any accidental wounding of the owner or his friends. When carried in an open quiver they are either put head downwards or each head is wrapped in a separate leaf.

The poisons used by different tribes differ much in deadliness, and even the same poison is not always equally effective. The active principle may tend to decompose, and thus the virulence is lessened ; if the poison be fresh and moist it is rapidly absorbed from the wound and is speedily fatal, but if old and dried it dissolves much more slowly in the body fluids. Its action is thereby more slowly developed, and if it can be removed in time the wounded man may recover. Some of them must retain their virulence unimpaired for a very long time, as Lewin found a Bushman arrow-poison still active which had lain for ninety years in the Museum for Anthropology at Berlin.—*Pharmaceutical Journal.*

(To be continued.)

ON THE CAUSE OF SO-CALLED PHOSPHORUS NECROSIS OF THE JAW IN MATCH-WORKERS.

By Ralph Stockman, M.D., F.R.C.P.E., Professor of Materia Medica in the University of Glasgow.

Historical Summary.

Phosphorus was first used in the manufacture of matches in 1833 at Vienna. Shortly after its introduction, and ever since, cases of necrosis of the bones of the upper and lower jaws have occurred among the workpeople employed in match factories. The condition was first described by Lorimer, who, between the years 1839 and 1845, saw 9 cases in Vienna, but immediately after cases were also reported in Nürnberg, Strassburgh, Berlin, Lyons, Paris, Manchester, and London as having occurred among the workers in match factories. Improvements in ventilation and in manufacturing machinery have greatly diminished its frequency, but it has continued to be not uncommon, and is widely recognised as a risk incurred by those who work with phosphorus. The clinical symptoms have been fully described by Lorimer, Heyfelder, von Bibra, and Geist, Harrison, Roussel, and others. In addition to their more systematic descriptions many isolated cases have been put on record by different writers, and all agree substantially in their main features.

Symptoms and Course.

The disease may begin after a few weeks or months, or many years' employment in the factory, generally with toothache, and always in a carious tooth or in the socket of one which has been extracted. Its further progress may be very slow, the pain and inflammation remaining slight, and confined to the immediate area of the one tooth. Sometimes, however, it runs a much more acute course, and may involve a large part of the jaw in a few weeks or months. In either case, when the process once begins to extend, the gum becomes red, tense, and swollen, and the swelling may then resolve itself into a circumscribed phlegmon, or may form a large tumour which spreads to the neighbouring soft parts, causing a swollen appearance of the lips and cheeks, or the regions under the lower jaw. The abscess then bursts or is opened, when it discharges stinking pus, and in its place an ulcer quickly forms, which lays bare the bone. The discharge is greenish, greyish, or sanious, and contains a quantity of bony detritus. The teeth become loose and fall out at the diseased part ; the gum becomes livid, and fistulous openings form in it from which pus discharges continuously into the mouth, or the pus may burrow and discharge externally through the skin of the face by several small openings. On probing these openings, bare bone can be felt. Later the gum disappears, and exposes the alveolar arch and other parts of the jaw, the bare bone having a brownish or dirty-grey colour ; its surface is roughened and eroded, evidently in a condition of caries, and the pus can be seen oozing from its surface. The salivary or neighbouring lymph glands are hard and swollen. Larger or smaller portions of the jaw-bone then become necrosed, in process of time get loosened and detached from the rest, and ultimately exfoliate or can be easily removed with forceps. There is great difficulty in chewing and swallowing, and the patient has to live on soft food and liquids. The process may last for months or years, and may be entirely confined to the upper or lower jaw, the general health remaining fairly good. It may spread from one part of the jaw to another, or from one jaw to the other.

In the most favourable cases, after portions of the jaw have necrosed and been removed, the whole process may cease, new bone is formed from the periosteum, and cicatrisation of the soft parts takes place. But there is always more or less deformity, sometimes very slight, sometimes very severe, and the alveolar arch is never restored.

In other cases the disease, instead of healing, spreads locally, involving more bone, the patient becomes cacchectic, feverish, and wasted, and ultimately dies of pulmonary phthisis, general tuberculosis, or some other tuberculous affection. A few cases run a very acute course, both as regards the local and general conditions, there being very great destruction of bone and very severe systemic disturbance, death occurring in two or three months.

Pathology.

As regards the bone, the condition is one of cario-necrosis, there is chronic ostitis and periostitis, and it differs in no respect from the same lesion as seen in other bones and from various causes.

It has long been held that this necrosis, or cario-necrosis as it should rather be termed, is due to a specific action of phosphorus fumes on the bone, these being supposed to cause a peculiar and specific kind of inflammation. If one considers, however, the whole circumstances and the clinical histories of individual cases, the conclusion must inevitably be drawn that the process is due to infection from a micro-organism. Phosphorus fumes consist of phosphorous anhydride (P_4O_6) chiefly, with some phosphoric anhydride (P_2O_5), and during the oxidation either ozone or hydrogen peroxide is also formed in small amount. From what we know of suppurative processes, it is inconceivable that any of these bodies can cause a chronic purulent inflammation of bone such as has just been described as occurring in "phossy jaw."

Acting on this idea I applied to Mr. Cornelius E. Garman, surgeon to Messrs. Bryant and May's match factory, who very kindly has supplied me with specimens of pus from six cases of phosphorus necrosis of the jaw under his care at the present time. In every case the pus was very fœtid and was greenish, or brownish, or greyish in colour. Attempts to make cultivations from the pus revealed the presence of staphylococcus albus, streptococci, and numerous other organisms, none of which could reasonably be regarded as the cause of the cario-necrosis.

Presence of Tubercle Bacilli.

It is well known that tubercle bacilli cannot be cultivated from pus, but on staining cover-glass preparations of the pus by the Ziehl-Neelsen method the bacillus tuberculosis was found in every case. As is usual in the discharge from tuberculous bone, the organisms were few in number and difficult to find except on the closest and most careful examination. On centrifuging the pus and then examining the sediment they were more easily detected. Sometimes several cover glasses had to be examined before any of the organisms were seen. Most of the bacilli were perfectly typical in appearance, others were small and thick, resembling the forms usually found in the urine. They were scattered about singly, or in small clumps, or in groups of one or several dozens.

Inoculation of guinea pigs with the pus did not infect these animals with tubercle, and hence the bacilli must be regarded as being either dead or as having almost entirely lost their infective virulence. It is now proved, however, that tubercle bacilli in this condition are quite capable of setting up and maintaining local suppuration and irritation for an indefinite time. Besides, they are assisted by the action of the pyogenic organisms with which the pus swarmed. The condition of the tubercle bacilli is probably to be explained by the fact that all the cases which I have had an opportunity of examining are recovering, and have been under treatment for very long periods with antiseptic mouth washes, etc. The condition generally is exactly similar to what is seen in tuberculosis of the jaw in cattle and in tuberculous disease of other bones in man. The presence of the tubercle bacillus can hardly be regarded as fortuitous, seeing that it was found in every case, and its presence is held, so far as our present knowledge goes at least, to be proof positive of the tuberculous origin of any lesion.

If further proof of the tuberculous nature of the jaw disease were wanted, it is to be found in looking through the accounts of post-mortem examinations of fatal cases. In most cases death occurs from tuberculosis of the lungs. Whether this is due to infection from the jaw tubercle, or whether the phosphorus fumes damage the lungs, and make them more susceptible to direct infection, I am unable to say.

General tuberculosis is also not uncommon, while tubercle of the abdominal glands, and tuberculous ulcers of the intestine, are almost invariable, these last arising certainly from infection by swallowing the pus. Abscess in the brain, purulent pleurisy and tuberculous meningitis are also occasional causes of death. Hectic fever and emaciation always accompany fatal cases.

The part which the phosphorus plays in the process is not far to seek. The acid fumes (phosphorous and phosphoric acids) produced by its oxidation in the air have no effect on bone covered by gum or mucous membrane; but when they can penetrate to the bone directly through the aperture left by a decaysd or extracted tooth or any injury, they erode the bone, weaken its nutrition and resisting power at this small spot, and make it susceptible to infection by tubercle bacilli. The bacilli having made good their foothold, spread slowly in some cases and with disastrous rapidity in others. I think I am correct in saying that the great majority of workers in match factories have carious teeth, and yet only a very small proportion of them become affected with cario-necrosis of the jaw—namely, those of them who, owing to their home surroundings or to individual predisposition, become readily infected by the tubercle bacillus. V. Bibra and Geist state that the disease may occur weeks or months after the patient has left the match factory, and in one of their reported cases the woman had actually been eighteen months away from the work before any symptoms began. This in itself is almost complete proof that the phosphorus fumes are only a predisposing cause, and that the disease depends on subsequent infection. It is well known that V. Bibra and Geist, and later Wegner, produced suppuration and cario-necrosis in the jaws of rabbits by injuring the periosteum and then exposing the animals to phosphorus fumes (on uninjured rabbits the fumes had no effect). The rabbits all died in from five to ten weeks' time and were found to have tubercle of the lungs. I experimented in a different way, as it is evident that these animals had become rapidly infected from the laboratory cages in which they were kept. I got new wooden hutches made, placed them in a room where animals had not been previously kept, and kept them scrupulously clean. In the hutches pieces of phosphorus were placed in a mortar on damp earth (to avoid risk of fire) in such quantity that the cages were constantly filled with the fumes in much greater amount than can possibly occur in any factory. Four rabbits were then placed in the hutches after the periosteum and gum had been removed over a considerable portion of the upper and lower jaws in each. In one a tooth was loosened in addition, the operations being all performed under chloroform. They seemed to suffer no inconvenience either from the operation or from living in the phosphorus-fumes atmosphere. It has been very difficult to prevent the gums growing over the exposed bone, and after many weeks there is not the slightest trace of any jaw affection. The exposed surface of bone has become slightly eroded and rough, but whether from the action of the acid fumes or from that of the bacilli of the mouth it is impossible to decide.

Treatment.

The treatment hitherto pursued in cases of phosphorus jaw has been to wash out the mouth with deodorant and antiseptic lotions, and wait until the necrosed pieces of bone come away. This is always extremely tedious, and may last many years. In extreme cases the whole lower jaw, or half of it, or parts of the upper jaw have been excised. Sometimes by so doing the whole of the infected portion may be removed, but frequently the disease has again broken out in a neighbouring part of the bone. It is evident, however, that early operative interference is called for, and that the original tuberculous focus at the root of the tooth should be removed at once.

Prophylaxis.

As regards prophylaxis, there is absolutely no risk so long as the bone remains protected by gum, and even when carious teeth are present the entrance of the bacilli can be prevented by careful stopping. Efficient ventilation of the workshops will dilute the acid fumes arising from the phosphorus, and make them less active in injuring exposed bone. The infection with the tubercle bacilli is a matter quite apart from the factories, and cannot be controlled either by State regulations or workshop rules. It is acquired—as other tuberculous affections are acquired—by certain persons and not by others, and owing to the present all-pervading frequency of the organism persons with exposed bone eroded by acid fumes, and living under bad hygienic conditions, are very apt to become infected. Whether the fumes also weaken the mucous membrane of the lung alveoli and predispose to pulmonary phthisis among persons employed in match factories, I have no information which will enable me to decide. It is just possible that actinomyces or other organisms may also occasionally lodge in the weakened bone, and lead to caries and necrosis, but in those cases which I have hitherto examined I have only found the tubercle bacillus.

My great difficulty all along has been to procure a sufficient amount of clinical material to enable me to make my observations more extensive and precise, and I

shall be greatly indebted if any surgeon who has cases under his care, and more especially recent ones, will supply me with specimens of the discharge.

In conclusion, I have to express my great indebtedness to Mr. Garman and his son for a great deal of information and assistance, as without their active help and co-operation I could not have made these observations.—*Brit. Med. Journal.*

THE BACTERIAL ORIGIN OF BILIARY CALCULI.

Mignot (*Arch. Gén. de Méd.*, August, 1898.), refers to the usually accepted theory that for the production of gall stones a special diathesis is necessary. Even those who, owing to the discovery by Gilbert and others of living bacteria in the centre of biliary calculi, believe that bacteria are the exciting cause, generally consider that a diathesis is a necessary predisposing cause. This, however, is a mistake. The author has succeeded in producing typical calculi in guinea-pigs and has obtained the following results: (1) Foreign bodies when introduced into the gall bladder can stay there for an indefinite time, provided they are aseptic, without causing inflammation or precipitating the solids from the bile. (2) Foreign bodies previously impregnated with virulent micro-organisms cause a more or less intense cholecystitis and precipitate the solids from the bile. As long as the bacteria retain their virulence, however, they cannot form a calculus, but only a sediment mixed with pus. This precipitate has no tendency to cohere or to adhere to foreign bodies. (3) Mignot then shows why previous attempts to form calculi have failed. The bacteria must be attenuated, not virulent. This is best attained by growing them for some months in bile to which constantly decreasing amounts of broth are added. When sufficiently attenuated they are no longer pathogenic when injected into the cellular tissue of animals. By injecting these into the gall bladder stones are occasionally formed, but more often the bacteria are washed out into the intestine. If, however, a foreign body, especially if porous, such as cotton wool, be placed in the bladder and fixed to its wall to prevent expulsion, a stone is formed round it with the greatest certainty. Five or six months are required for the formation of a perfect calculus. The kind of bacteria injected seems to be of quite secondary importance. Mignot has proved that typhoid bacillus, the B. coli, staphylococci, streptococci, and even the non-pathogenic B. subtilis, are capable of giving rise to calculi, and probably a great number of other organisms are equally so.—*British Medical Journal.*

ANIMAL AND MEAT INSPECTION IN U.S.A.

From the report of the United States Bureau of Animal Industry, it appears that in the fiscal year 1898 there were 9,228,237 *ante-mortem* inspections of cattle, 10,028,287 of sheep, 468,199 of calves, and 31,610,675 of pigs, the total being 51,335,398, or 9,025,291 more than in 1897. There were 10,591 condemnations of abattoirs, comprising 104 cattle, 741 sheep, 67 calves, and 9,679 pigs. The rejections in stock-yards numbered 27,491 cattle, 9,594 sheep, 2,439 calves, 66,061 pigs, the total being 105,585. The number of animals condemned at abattoirs was 3,275 fewer than in 1897, and the number rejected in stock-yards was 27,247 more. These differences show how careful is the work of the officials in detecting disease previous to the slaughter of the animals. The post-mortem work included 4,438181 inspections of cattle, 5,501,675 of sheep, 245,155 of calves, and 20,936,840 of pigs. Of the carcases condemned 10,018 were of cattle, 3,567 of sheep, 344 of calves, and 77,579 of pigs. The meat-inspection tag, or brand, was placed on 14,815,753 quarters, and 968,014 pieces of beef, 5,448,477 carcases of sheep, 217010 carcases of calves, 680,876 carcases of pigs, and 394,563 sacks of pork. The meat-inspection stamp was affixed to 4,433,569 packages of beef products, 5,163 packages of mutton, and 10,145,043 packages of pig products, of which 374,131 contained microscopically-examined pork. Two abattoirs have been established—one in Oregon and one in Massachusetts—for the inspection of horses and horse products, and the percentage of condemned animals is found to be large. Regulations are in progress for the inspection of live horses for export; it is believed that such inspection will stimulate the demand for American horses, especially in England.

THE TUBERCULIN TEST.

Medical Officer's Interesting Report.

Dr. Barwise, medical officer of health for Derbyshire, in his annual report, says: "In the last annual report I published a model code of regulations for dairies and cowsheds, and pointed out the advantage of having cows tested with tuberculin as a diagnostic reagent for tuberculosis. I am pleased to say that a start has been made in the county by Lord Vernon, who has remodelled two farms so as to comply with the regulations published. Each cow has been provided with 800 cubic feet of air space, the cowsheds have had adequate windows introduced, so that the direct sunlight may reach all parts of the cowshed, the drainage has been overhauled, the floors made impervious, and the sheds have been properly ventilated. In addition to this over 200 cows have been tested with tuberculin by Mr. Abell, M.R.C.V.S., of Derby, who in his report states that although the cows to all appearances were healthy, yet as many as 54 per cent. had to be rejected as being tubercular. The cows which proved to be tubercular were isolated at once prior to being fed up for slaughter. The cows which were proved to be free from tubercular taint were removed to the new cowsheds, where they are kept under perfectly clean and sanitary conditions. The yard into which the milk is brought is paved with asphalt and has a good fall, so that it can be kept clean. Each farm has a refrigerator through which the milk is passed immediately after milking, it is then passed through a centrifugal machine to remove any accidental impurities, and finally, to avoid all possible risk from pathogenic organisms, it is decanted into bottles, by an arrangement of machinery which obviates the necessity for any handling. The bottles are then heated to 186deg. F., they are then suddenly cooled and left for two hours, during which time any highly resistant spores have grown into less resistant 'adult' germs, when the bottles are again heated to 212deg. F. for twenty minutes, and the milk completely sterilised. As the bottles are removed from the sterilising apparatus, an automatic arrangement closes them hermetically, and they are again rapidly cooled. The sterilised milk will keep any length of time. I can only hope that the increased price which the milk realises will be sufficient to induce other landowners to follow the example set by Lord Vernon."—*Leicester Daily Mercury.*

TUBERCULOSIS IN CATTLE.

In the recent number of the British Dairy Farmers' Association's "Journal," the subject of tuberculosis is considered from four points of view, namely, the scientist's, the farmer's, the dairyman's, and the housewife's.

Mr. Christopher Middleton, looking at the subject from the farmer's point of view, says:—"Unfortunately, the case against milk is somewhat stronger, for the decrease of infantile mortality from this disease is not nearly so marked, and undoubtedly a certain percentage of deaths may be ascribed to infection from this source. Much, even, of this death-rate, however, is preventable, as any milk, however dangerous it may be, can be rendered perfectly innocuous by boiling; and though there is a strong prejudice against cooked milk among adults, this scarcely exists, or need not be considered, in the case of children. But, apart from this, I venture to suggest that the risk of contracting tuberculosis from milk is very much smaller than is generally believed; and I do so for this reason—that the exhaustive experiments carried out on behalf of the Royal Commission on Tuberculosis, which was appointed in 1890, and which reported in 1895, showed conclusively that, unless the udder of a cow suffering from tuberculosis was affected, her milk was perfectly harmless, and I think most authorities will agree that the disease does not frequently extend to that organ.

The question to be considered is, How can the public be best secured against any possible risk of infection from either of these sources, without at the same time inflicting injustice or unnecessary loss upon farmers or stockowners?

So far as meat is concerned, my opinion is that the risk of contracting tuberculosis by consuming the flesh of animals affected with this disease is somewhat remote, and I feel certain that much perfectly wholesome food has been condemned and destroyed without the slightest necessity for doing so. At present the loss arising through the seizure of such carcases generally falls upon the person in whose possession they are found, viz., the butcher; but this loss to a certain extent reacts upon the farmer, for it may be taken for granted that butchers who buy the class of animals most liable to be affected—viz., fat cows—will not give the same price they otherwise would if it were not for the risk they run of having the carcases of such confiscated. The only equitable remedy for this appears to be that when the well-nourished carcase of an apparently healthy animal, which after slaughter is found to be tuberculous, is condemned in the interest of the public health, the owner should receive full compensation.

I hold the opinion very strongly that the surest way by which the public can be secured from the risk of tuberculous milk would be by the adoption of the recommendation of the Cattle Diseases Committee of the Central and Associated Chambers of Agriculture (Feb., 1897). This recommendation is as follows:—"That the owners of milking cows visibly affected with tuberculosis, or having chronic diseases of the udder, or found to yield tuberculous milk, should be compelled to notify the fact, and that such animals should be at once slaughtered, and compensation paid for them out of Imperial funds to the extent at least of three-fourths of their value. With the view of giving effect to this suggestion, there should be inspection of all dairies at stated intervals by a veterinary surgeon appointed by the Board of Agriculture." It is urged that the cost of such inspection would be very great. Undoubtedly, if carried out frequently enough to ensure its object, it would amount to a considerable sum. But the almost absolute safety secured by adequate inspection, along with compulsory notification, would not be dear at the price.—*Farm, Field, and Fireside.*

Veterinary Science in Natal.

Mr. H. Watkins-Pitchford, the Principal Veterinary Officer of Natal, has been devoting a good deal of attention to the question of the preventive treatment of animals subject to the disease of redwater, which from the colonial stockowner's point of view ranks next in importance to horse sickness. Owing to the fact that imported animals are liable to the disease it is impossible to either improve the stock of the country or restock it. Mr. Pitchford believes, however, that immunity for the imported stock will be secured by inoculating them with a milder form of the disease, and experiments are to be made at once to test the truth of his theory. In conjunction with Surgeon-Major Bruce, Mr. Pitchford is also investigating the disease of horse-sickness, and although he modestly declines to express an opinion of the possibility of success in a field where so many have failed, he says that this is no reason for leaving so important a disease uninvestigated.

One of the Ameer's Experts.

Mr. Clements, veterinary surgeon to the Ameer Abdurrahman, has arrived in India and says that his Highness is in a bad state of health and cannot be expected to live long. Mr. Clements adds that the Ameer has become extremely parsimonious, and leaves the greater part of the salaries due to Europeans in his service in arrear. He also states that letters of British residents in Kabul are frequently intercepted and confiscated.

[There is no such name in the Register of Members of the R.C.V.S. but there is a Mr. Clements on the list of Registered Practitioners.—Ed.]

NEW BOOKS, ETC.

A MANUAL OF BACTERIOLOGY.

Gradually veterinary literature in all its branches is being enriched by works written by veterinary surgeons. Anatomy, Materia Medica, Medicine and Surgery have all had their veterinary authors for years past. Until Professor F. Smith wrote on Physiology and Hygiene we had to go to medical authors for our text books on those sciences. On bacteriology we have had no veterinary work—unless we might put in a partial claim to the splendid work by Professor Crookshank.

Now, thanks to Professor Bowhill we have "A Manual of Bacteriological Technique and Special Bacteriology," by a fellow of the R.C.V.S.

The book is beautifully illustrated by more than a hundred woodcuts and photo-micrographs, all of which, save three or four acknowledged, are the original work of the author from specimens of his own preparation. The work is a trustworthy and handy guide for any student—old or young. Controversial matters are omitted and a clear account, in a concise style, given of micro-organisms, their classification, morphology and cultivation. The author claims that "the technique and working methods have been carefully selected, and from the mass of available material on this rapidly growing branch of the subject only those methods and material have been chosen which possess distinctive benefits." The claim is well justified.

The book is divided into Parts and Chapters, and the arrangement followed is to treat the subject in this order:—The Classification and Morphology of

Bacteria, Methods of Sterilisation, Principles of Bacteriological Technique, Preparation of Nutrient Media, Methods of Cultivation, Special Bacteriology, The Hyphomycetes or Mould Fungi, The Blastomycetes or Yeast Fungi, Pathogenic Blastomycetes, The Protozoa or Animal Parasites.

The section on Special Bacteriology treats of all the organismal diseases of man and animals, and will afford information not only to the worker in the in the laboratory but to those who merely desire a book of reference. If we take Tuberculosis as a sample we find the subject treated in a systematic manner under the following sub-heads—Microscopic Appearances, Spore-formation, Staining Reactions, Biological Characters, Vitality, Pathogenesis, and concluding with special paragraphs on Bovine, Equine, Canine, Porcine, Avian and Pseudo-Tuberculosis.

The publishers, Messrs. Oliver and Boyd, have done their work well, and we congratulate them and the author on having made a useful and sound addition to veterinary literature.

"THE STABLE."

A new weekly journal under this title has just made its appearance. The first number promises well and we should think a sufficient clientele can be found to make it a permanent addition to our periodicals. It is of convenient size, well written and printed, and only 3d.

Naturally veterinarians are interested in such a journal, but we doubt whether the Editor is well advised in devoting a column to "Opinions of noted vets." These interviews are apt to be misunderstood.

THE LIVE-STOCK JOURNAL ALMANAC.

The word "Almanac" is becoming inappropriate for this volume. It this year extends to nearly 300 pages, and is a little encyclopædia of practical live-stock knowledge. Every article is by a master, and we need only mention a few to show their value. Mr. G. S. Lowe leads off with a paper on the thoroughbred horse Marske, and his descendants; this famous sire having laid the foundation of one of the greatest families of race-horses. Next follows a short and pithy article by Mr. P. A. Muntz, M.P., on "The Importance of Good Mares." Sir Walter Gilbey has chosen for his subject "The Horse in History," and he supplies a succinct account of what is known of the measures adopted for the improvement of our breeds from the time of Cæsar until now. Several fine illustrations are given with this. Sir Richard D. Green-Price has a theme to which he does full justice in "Cross-breeding in Hunters." Dr. George Fleming treats of "Twisted Bowels in Horses." One of the most readable papers is that by Mr. C. Stein on "Swimming Horses." "Farmers and Harness Horse Breeding" is the subject of a paper by Mr. Vero Shaw. Professor Wortley Axe comments on the arrangements for the "Conveyance of Horses by Rail." Mr. Wm. Housman has a paper on "Aids to Judgment in Stock Breeding," in which he refers to the value of breed records, and also to Mr. Francis Galton's efforts to reduce vague general knowledge of stock breeding to the solidity of a definite law. Next comes Professor Penberthy on "Black Quarter," and "Economical Calf Rearing" by Mr. Robert E. Turnbull. Pigs, dogs and poultry are also treated fully and well. The Almanac is profusely illustrated throughout, and will be found full of interesting matter for all who have a liking for country life and rural pursuits. The price is one shilling, Messrs. Vinton and Company, 9, New Bridge Street, Ludgate Circus, London, E.C., being the publishers.

CORRESPONDENCE

UNQUALIFIED CASTRATORS.

Sir,

Has'nt Mr. Upton put the cart before the horse when he complains of the unqualified castrator? The latter was first on the ground and taught the qualified men the elements of his art. The castrator may or may not be willing to give place to the V.S. in the doctoring of horses and cattle, but where both classes of castrators exist in a district, the unqualified man has generally the best reputation for his particular sort of work. A diploma is a good thing, but it does not impart any special manual dexterity to the proud possessor, who often finds the man of largest experience and with the ancient but truly aseptic hot iron the most successful, judged by the number of deaths that follow his visits.

A Venerable Quack.

Dear Sir,

Your correspondent, George Upton, in last week's issue ventilated a genuine grievance of the country practitioner, the removal of which would leave the profession hundreds of pounds richer annually. I have often wondered whether the Council has the power to put down the unqualified castrator, and if not whether it could obtain such power.

The success which follows the operation as performed by many of our members leaves nothing to be desired. With others, however, the results are disastrous. Certain M.R.C.V.S. decline or would much rather not castrate at all, others are quite willing to operate on horses, but draw the line at speying pigs, probably because they can't. On the other hand the unqualified castrator is, unfortunately for the qualified veterinary surgeon, too often a most capable and successful operator. I have known several of these men, have seen them operate, watched the results, and am not at all surprised at their being preferred to many M.R.C.V.S. That many of them earn a better living than some veterinary surgeons is not at all surprising when we know that in the same or little more time than it takes the surgeon to make a visit for which he may receive a modest half crown, the unqualified castrator may have earned a sovereign. I must frankly admit that those unqualified castrators whom I have known, both as regards their method of operating and the successful results thereof, deserve the confidence of the public, and I would ask how many of our newly-fledged veterinary surgeons could operate on a litter of ten pigs (five male and five female) in as many minutes, or castrate a colt—the quietest in the world—in three minutes?

Grumph.

Communications, Books, and Papers received:—Messrs. C. M. Holme, G. Upton, J. D. Pottie, S. Upcott Gill. "A Venerable Quack," "Grumph."

"*The Stable*," *Sunderland Herald*, *The Devizes & Wiltshire Gozette*.